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• Helliwell, Colin James  
Lincoln LN1 1RT (GB)

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(71) Applicant: PLESSEY SEMICONDUCTORS  
LIMITED  
Swindon, Wiltshire SN2 2QW (GB)

(74) Representative: Hoste, Colin Francis  
The General Electric Company p.l.c.  
GEC Patent Department  
Waterhouse Lane  
Chelmsford, Essex CM1 2QX (GB)

(72) Inventors:  
• Smith, Gregory Jonathan  
Lincoln LN6 0YG (GB)

### (54) Transceiver synchronisation in a frequency hopping wireless LAN

(57) In wireless local area networks utilising frequency-hopping between different channels spaced over an allotted frequency band, two or more groups of transceivers in close proximity may be arranged to operate satisfactorily with the full bandwidth available to

each by arranging that their hop sequences are kept separate. This may be achieved by arranging for the hop sequence of one group or of each group to skip at intervals from one point to another in the sequence, chosen at random.

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## Description

The present invention relates to wireless local area networks, or wireless LANs.

Present bandwidth usage requirements dictate that wireless LAN transceivers operate in a spread-spectrum mode, for example by frequency-hopping between a plurality of channels spaced throughout an allotted frequency band, in a predefined sequence, such that every channel is used equally. For a group of transceivers to communicate with one another, the sequence of channel hopping must be known by all of the transceivers, and the transceivers of a group must be coordinated so that they hop in synchronism and to the same channel.

Wireless LANs may operate, for example, in the industrial, scientific and medical (ISM) band, 2.4 to 2.5 GHz, within which are defined some eight-two channels each 1 MHz wide, and transceivers may hop between these channels in a predefined pseudo-random sequence, occupying each channel in the sequence for some 40msecs. The pseudo-random sequence may, for example, be derived from a look-up table or from a sequence generator based on a shift register with feedback from taps at intermediate points along the register.

One advantage of frequency-hopping spread-spectrum operation is that where two groups of transceivers are located in close proximity each group may have the full bandwidth available to it, provided that their hop sequences are kept separate so that they do not use the same channels at the same time.

The two groups may be separated by setting them up to use different hop sequences, but this requires deliberate intervention, such as from a system manager, to control the configuration of the transceivers in the two groups. While this may be acceptable in some situations, wireless LANs readily lend themselves to use by so-called ad-hoc groups of users, where there is no provision for such centralised management. In such a case two or more groups may be set up with the same hopping sequence, making it possible for them to become synchronised or locked together so that they are using the same channels, leading to reduced performance.

According to one aspect of the present invention in a wireless local area network comprising a plurality of transceivers operable in a frequency-hopping spread-spectrum mode, the transceivers being arranged to hop in synchronism between different ones of a plurality of channel frequencies spaced throughout an allotted band of frequencies in a predefined pseudo-random sequence, with one of the transceivers operating to coordinate the hopping sequences of said plurality of transceivers, said one of the transceivers is arranged at intervals to effect a skip in said hopping sequence between non-consecutive points in said sequence.

Preferably said intervals and said skips are each of random length. Said one of the transceivers may be arranged to transmit coordinating information on one or more, or each, of said channel frequencies as or while

it is selected during said sequence.

According to another aspect of the present invention there is provided a transceiver for use in a wireless local area network comprising a plurality of such transceivers operable in a frequency-hopping spread-spectrum mode, the transceivers being arranged to hop in synchronism between different ones of a plurality of channel frequencies spaced throughout an allotted band of frequencies in a predefined pseudo-random sequence, the transceiver being operable to coordinate the hopping sequences of said plurality of transceivers and being arranged at intervals to effect a skip in said hopping sequence between non-consecutive points in said sequence.

5 Preferably said intervals and said skips are each of random length. The coordinating transceiver may be arranged to transmit coordinating information on one or more, or each, of said channel frequencies as or while it is selected during said sequence.

10 20 A transceiver for a wireless local area network in accordance with the invention will now be described with reference to the accompanying drawing, which shows the transceiver schematically.

25 Referring to the drawing the transceiver comprises transmit/receive circuits 1 by means of which data or information from a user 2 may be transmitted over the network or information for the user 2 may be received from the network, at channel frequencies determined by a local oscillator 3. The operating frequency of the oscillator 3 may be controlled by means 4 to hop between channel frequencies of a set in a predetermined sequence under the control of a pseudo-random sequence generator 5. The generator 5 may be made to skip from one point to another in the sequence by a skip generator 6.

30 35 On each channel in a sequence the coordinating transceiver on a network may be arranged to transmit timing information to indicate to other transceivers on the network when to hop to the next pre-defined channel. Also transmitted with this timing information may be

40 45 information instructing other transceivers to skip to, say, channel X in Y hops time. The generator 6 of the coordinating transceiver periodically, say every 10 to 15 seconds, chooses a channel (at random) to skip to, and begins counting down the number of channel hops to go until this skip is to be performed. This channel number and the countdown are transmitted to all the other transceivers so that they are forewarned of the impending skip, and can maintain their own countdown to the event even if any subsequent transmissions of the information 50 are missed.

## Claims

- 55 1. A wireless local area network comprising a plurality of transceivers operable in a frequency-hopping spread-spectrum mode, the transceivers being arranged to hop in synchronism between different

ones of a plurality of channel frequencies spaced throughout an allotted band of frequencies in a pre-defined pseudo-random sequence, with one of the transceivers operating to coordinate the hopping sequences of said plurality of transceivers, wherein said one of the transceivers is arranged at intervals to effect a skip in said hopping sequence between non-consecutive points in said sequence.

2. A wireless local area network in accordance with Claim 1 wherein said intervals and said skips are each of random length. 10
3. A wireless local area network in accordance with Claim 1 or Claim 2 wherein one of the transceivers is arranged to transmit coordinating information on one or more, or each, of said channel frequencies as or while it is selected during said sequence. 15
4. A transceiver for use in a wireless local area network comprising a plurality of such transceivers operable in a frequency-hopping spread-spectrum mode, the transceivers being arranged to hop in synchronism between different ones of a plurality of channel frequencies spaced throughout an allotted band of frequencies in a predefined pseudo-random sequence, the transceiver being operable to coordinate the hopping sequences of said plurality of transceivers and being arranged at intervals to effect a skip in said hopping sequence between non-consecutive points in said sequence. 20
5. A transceiver in accordance with Claim 4 wherein said intervals and said skips are each of random length. 25
6. A transceiver in accordance with Claim 4 or Claim 5 arranged to transmit coordinating information on one or more, or each, of said channel frequencies as or while it is selected during said sequence. 30

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